#### Syllabus

#### VK Multi-platform low-level programming

Subjects:	Multi-platform low-level programming
Level of higher education:	first (undergraduate)
Course page in Moodle:	https://dl2022.khadi-kh.com/course/index.php?categoryid=39
The scope of the	3 credits (90 hours)
educational	
component	
Final control form	Test
Consultations:	on schedule
Name of the department:	department of computer technologies and
	mechatronics
Teaching language:	English
Course leader:	Shulyakov Vladyslav Mykolayovych, Ph.D., associate
	professor
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### Brief content of the educational component:

**The goal is**deep and thorough assimilation by students of basic algorithms for solving typical problems and their implementation using low-level programming. The named course should contribute to the formation of highly qualified specialists in the field of information technologies.

**Subject:**architecture, structure, parameters and capabilities of microcontrollers, core and peripherals of microcontrollers, software automated tools for development and debugging of program codes for microcontrollers, assembly language as 8-

bit and 32-bit microcontrollers, microcontroller programming in the C language.

The main tasks of studying the academic discipline is to ensure the student's familiarity with the architecture, structure, parameters of 8-bit PIC microcontrollers; medium-level microcontrollers, assembly language, means of designing and developing software in assembly language and C.

### Prerequisites for studying the educational component:

- Algorithmization and programming;
- Higher mathematics;
- Theory of algorithms;
- Cross-platform programming.

### Competencies acquired by the acquirer:

#### General competences:

- The ability to evaluate and ensure the quality of performed works;
- Ability to design software;

 Ability to apply methods, tools and technologies of structural-functional and object-oriented programming.

#### Special competences:

 Ability to computer implementation of mathematical models of real systems and processes to design, apply and support software tools for modeling, decision-making, optimization, information processing, intelligent data analysis;

- Ability to develop algorithms and data structures for software products;

 Ability to solve complex specialized tasks or practical problems characterized by complexity and uncertainty of conditions, using theories and methods of information technologies;

### Learning outcomes according to the educational program:

- Know the latest technologies in the field of computer science;

- Be able to perform experimental research on professional topics;

- Be able to evaluate the obtained results and justify the decisions made;

- Know and understand the scientific principles underlying the functioning of computer tools, systems and networks;

- Have the skills of conducting experiments, data collection and modeling in computer systems;

- Be able to apply knowledge for identification, formulation and thematic plan.

Topic No		Number of hours	
	Name of topics (LK, LR, PR, SZ, SR)	ocular	extramural
1	<b>Lecture #1:</b> Microcontrollers. Harvard Architecture. Core, permanent memory, RAM, timers, peripherals.	2	
	Practical lesson 1	2	
	Tasks for independent work 1	7	
2	Lecture #2:PIC16 RISC machine codes. MPASM assembler. Microchip PIC microcontrollers. Technical description, architecture and structure of the PIC16F84A microcontroller. Electronic circuit diagram of microcontrollers.	2	
	Practical lesson 2	2	
	Assignment for independent work 2	7	
3	<b>Lecture #3:</b> Tools for developing programs for microcontrollers and simulating work PIC microcontrollers (MpLabX, KtechLab, Proteus). Basics of the assembler of PIC microcontrollers.	2	
	Practical lesson 3	2	
	Assignment for independent work 3	7	
4	Lecture #4: The structure of the program in MPASM assembly language. Special registers appointment. Basics of programming in the C language. Programming of digital input/output ports of microcontrollers.	2	
	Practical lesson 4	2	
	Assignment for independent work 4	7	
5	Lecture #5:Programming timers of microcontrollers, programming time delays. USART and EUSART serial communication module. Software and hardware implementation of asynchronous serial transmission and reception of information. Connecting the built-in ADC. Reading and writing data to static EEPROM memory.	2	
	Assignment for independent work 5	2 7	
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6	<b>Lecture #6:</b> Architecture and structure of STM32 microcontrollers. Core Cortex.	2	
	Periphery,		
	address buses and data buses.		
	Practical lesson 6	2	
	Assignment for independent work 6	7	
7	Lecture #7:Assembler of 32-bit	2	
	microcontrollers. Tire adjustment. CooCox		
	integrated development environment.		
	Practical lesson 7	2	
	Assignment for independent work 7	7	
8	Lecture #8:Programming of	2	
	microcontrollers in the C language.		
	Practical lesson 8	2	
	Assignment for independent work 8	9	
Together	Lectures	16	
	Practices	16	
	Independent work	58	

Individual educational and research task: not provided.

## Teaching methods:

- 1) verbal: 1.1 traditional: lectures, explanations, stories, etc.;
- 1.2 interactive (non-traditional): problem lectures, discussions, etc.;
- 2) visual: the method of illustrations, the method of demonstrations
- 3) practical: 3.1 traditional: practical classes, seminars;
- 3.2 interactive (non-traditional): trainings, "round table", brainstorming method.

# **Evaluation system and requirements:**

The concretization and detailing of the criteria and evaluation system, taking into account the specifics of the educational component, is carried out on the basis of the general criteria specified in STVNZ 7.1-02:2018 "Regulations on the Organization of the Educational Process at the Khnadu" (https://www.khadi.kharkov.ua/fileadmin/P Ychebotdel/norm dok/stvnz 7 1 02.pdf) and STVNZ 90.1-01:2021 "Evaluation of learning outcomes of higher education applicants" (https://www.khadi.kharkov.ua/fileadmin/P Standart/pologeniya/stvnz-90.1-01 2021.pdf).

# Current performance

**1** The current success of applicants for the performance of educational types of work in training sessions and for the performance of independent work tasks is evaluated using a four-point rating scale with subsequent transfer to a 100-point scale. During the evaluation of the current performance inare countedall types of work provided by the curriculumprogram

- **1.1** Lectures occupationare evaluated by definition quality implementation of specified tasks
- **1.2** Practical classes are evaluated by the quality of performance of a control or individual task, performance and design of practical work.
- **1.3** Laboratory occupation are evaluated quality about implementation reports about implementationlaboratory work.
- **1.4** Seminary occupation are evaluated quality implementation individualassignment/abstract.

**2** Evaluation of the current success rate of higher education applicants is carried out at each practical session(laboratoryor seminary) on a four-point scale("5", "4", "Z", "2")and are enteredinaccounting journalacademicsuccess

 – "excellent": acquirerflawlessly mastered the theoretical material, demonstrates deepknowledge of relevant topic or academic discipline, main provisions;

– "good": the applicant has mastered the theoretical material well, possesses the main aspects from primary sources and recommended literature, presents it in a reasoned way; has practical skills, expresses his thoughts on certain problems, but certain inaccuracies and errors are assumed in the logic of the presentation of theoretical content or in the analysis of practical ones;

– "satisfactory": the applicant has basically mastered the theoretical knowledge of the educational topic or discipline, orients himself in primary sources and recommended literature, but answers unconvincingly, confuses concepts, answers additional questions uncertainly, does not have stable knowledge; when answering questions of a practical nature, reveals inaccuracy in knowledge, does not know how to evaluate facts and phenomena, connect them with the future profession;

 "unsatisfactory": the applicant has not mastered the educational material of the topic (discipline), does not know scientific facts, definitions, hardly orients himself in primary sources and recommended literature, lacks scientific thinking, practical skills are not formed.

**3** Final scorebycurrent activity is recognized as an arithmetic averagesumpoints for each lesson, for individual work, current control works according to the formula:

$$K^{current} = \frac{K1 + K2 + \dots + Kn}{n}$$

where  $K^{current}$  – final assessment of success based on the results of current control;

*K*1,*K* 2,...,*K*n- evaluation of success*n*-th measure of current control;

*n*- the number of measures of current control.

Grades are converted inpoints according to the calculation scale (table 1).

point scale							
4-point scale	100- point scale	4-point scale	100- point scale	4-point scale	100- point scale	4-point scale	100-point scale
5	100	4.45	89	3.90	78	3.35	67
4.95	99	4.4	88	3.85	77	3.3	66
4.9	98	4.35	87	3.80	76	3.25	65
4.85	97	4.3	86	3.75	75	3.2	64
4.8	96	4.25	85	3.7	74	3.15	63
4.75	95	4.20	84	3.65	73	3.1	62
4.7	94	4.15	83	3.60	72	3.05	61
4.65	93	4.10	82	3.55	71	3	60
4.6	92	4.05	81	3.5	70	from 1.78 to 2.99 reassembly	from 35 to 59
4.55	91	4.00	80	3.45	69	from 0 to 1.77	from 0 to 34
4.5	90	3.95	79	3,4	68	repeated stu	idy

 
 Table 1– Recalculation of the average grade for the current activity into a multipoint scale

## **Final assessment**

**1** The exam is held after studyingeveryonetopics of the discipline and is composed of students of higher education during the examination session after the end of all classroom classes

**2** Applicants of higher education who have completed all types of work prescribed by the curriculum in the discipline are admitted to the exam:

- were present ateveryoneclassroom classes (lectures, seminars, practical);

- completed all missed classes on time;

- scored the minimum number of points for the current academic performance (at least 60 points, which responds n a national scale"3");

If the current performance in the discipline is lower than 60 points, the higher education applicant has the opportunity to increase his current point to the minimum before the beginning of the examination session.

**3** Assessment of the knowledge of applicants when taking the exam is carried out on a 100-point scale.

Assessment of the knowledge of applicants through testing is carried out according to the following scale:

- "Excellent": at least 90% of correct answers;

- "Very good": 82% to 89% correct answers;
- "Good": from 74% to 81% of correct answers;
- "Satisfactory": from 67% to 73% of correct answers;
- "Fair enough": 60% to 66% correct answers;
- "Unsatisfactory": less than 60% of correct answers.

**4** The final grade for the academic discipline is defined as a weighted average grade that takes into account the overall grade for the current academic performance and the grade for passing the exam.

**5** The calculation of the overall final grade for the study of an academic discipline is carried out according to the formula:

# PKekz=0.6·Kpotoch+0.4·IS,

where  $PC^{ex}$ - final assessment of success in disciplines, in the form of a final report controls for which there is an exam;

 $K^{current}$  – final assessment of success based on the results of current control (on a 100-point scale);

*IS*- assessment based on the results of the exam (on a 100-point scale).

0.6 and 0.4

- coefficients of the ratio of points for current success and taking the exam.

**6** For performing individual independent work and participating in scientific events, winners are awarded additional points.

**6.1** Additional points are added to the total points scoredcakeof higher education for the current educational activity (for disciplines for which the final form of control is a credit), or to the final assessmentwithdisciplines, the final form of control for which is an exam.

**6.2** The number of additional points awarded for different types of individual tasks depends on their volume and importance:

prizes in the discipline at the international / all-Ukrainian competition of scientific student works - 20 points;

- prize places in the discipline at the All-Ukrainian Olympiads - 20 points;

- participation in the international / all-Ukrainian competition of scientific student

works

– 15 points

– participation in international / all-Ukrainian scientific conferences of students and young scientists - 12 points;

- participation in all-Ukrainian Olympiads in the discipline 10 points
- participation in olympiads and scientific conferences of the Khnadu in the discipline - 5 points;
- performance of individual scientific and research (educational and research) tasks of increased complexity 5 points.

**6.3** The number of additional points cannot exceed 20 points.

**7** General final rating by study educational disciplines not maybeexceed 100 points.

The overall final grade for the study of the academic discipline is determined according to the scale given in Table 2.

**Table 2** The scale for evaluating the knowledge of the students based on the results of the final control of the academic discipline

Score	Assessment by national scale examinat test ion		Evaluation according to the ECTS scale			
in points			Rating Criteria			
90-100	Perfectly	Enrolled V		The theoretical content of the course has been mastered in its entirety, without gaps, the necessary practical skills for working with the mastered material have been formed, all the educational tasks provided for in the training program have been completed, the quality of their performance has been assessed by the number of points close to to the maximum		
80–89	Okay	eq pa	В	The theoretical content of the course has been mastered in its entirety, without gaps, the necessary practical skills for working with the mastered material have mainly been formed, all educational tasks provided for in the training program have been completed, the quality of most of them has been evaluated with a number of points close to the maximum		
75-79	Enrol	WITH	The theoretical content of the course has been mastered completely, without gaps, some practical skills of working with the mastered material have not been sufficiently developed, all the educational tasks provided for by the training program have been completed, the quality of none of them has been evaluated with a minimum number of points, some types tasks were completed with errors			

67-74	actorily	Enrolled	D	The theoretical content of the course is partially mastered, but the gaps are not of a significant nature, the necessary practical skills for working with the mastered material are basically formed, most of the educational tasks provided by the training program have been completed, some of the completed tasks, may contain errors
60–66	Satisfa		E	The theoretical content of the course has been partially mastered, some practical work skills have not been formed, many of the educational tasks provided by the training program have not been completed, or the quality of some of them has been assessed with a number of points close to minimal
35–59	Unsatisfactorily		FX	The theoretical content of the course has been partially mastered, the necessary practical work skills have not been formed, most of the prescribed training programs of educational tasks have not been completed, or the quality of their implementation has been assessed with a number of points close to the minimum; with additional independent work on the course material, it is possible to improve the quality of the performance of educational tasks (with the possibility of repeated drafting)
0–34	Unacceptable	Not counted	F	The theoretical content of the course has not been mastered, the necessary practical work skills have not been formed, all completed educational tasks contain gross errors, additional independent work on the course material will not lead to any significant improvement in the quality of the performance of educational tasks (with a mandatory repeat course)

# **Course policy:**

- the course involves working in a team, the environment in the classroom is friendly, creative, open to constructive criticism;

- mastering the discipline involves mandatory attendance at lectures and practical classes, as well as independent work;

 independent work involves the study of individual topics of the academic discipline, which are presented in accordance with the program for independent study, or were considered briefly;

- all tasks provided by the program must be completed within the set time;

- if the student of higher education is absent from classes for a valid reason, he presents the completed tasks during independent preparation and consultation of the teacher;

- course work must be protected no later than a week before the beginning of the examination session;

- while studying the course, students of higher education must adhere to the rules of

academic integrity set forth in the following documents: "Rules of Academic Integrity educational participants process LOOKING

FOR"(https://www.khadi.kharkov.ua/fileadmin/P\_Standart/pologeniya/stvnz\_67\_01\_dobro

ch\_1.p df), "Academic Integrity. Verification of academic, scientific and qualification texts works on

plagiarism"

(https://www.khadi.kharkov.ua/fileadmin/P\_Standart/pologeniya/stvnz\_85\_1\_01.pdf), "Moral and ethical code of participants in the educational process of the National Sciences Academy of (https://www.khadi.kharkov.ua/fileadmin/P Standart/pologeniya/stvnz 67 01 MEK 1.

pdf).

- in case of detection of plagiarism, the applicant receives 0 points for the task and must repeat the tasks provided for in the syllabus;

- writing off during tests and exams is prohibited (including using mobile devices). Mobile devices are allowed to be used only during online testing.

## **Recommended Books:**

1. Simon HAThe Sciences of the Artificial (3rd Ed.) MIT Press, Cambridge, MA, USA (2006).

2. S. Farshidi, S. Jansen, R. De Jong, S. Brinkkemper, Multiple criteria decision support in requirements negotiation, in: The 23rd International Conference on Requirements Engineering: Foundation for Software Quality, REFSQ 2018, Vol. 2075, 2018, pp. 100-107.

3. Adrian, P.: What is low-code? https://www.alibabacloud.com/blog/what-islow-code\_597659, (2021).

4. Cabot, J.: Positioning of the low-code movement within the field of modeldriven engineering. In Proceedings of the 23rd ACM/IEEE International Conference on Model Driven Engineering Languages and Systems: Companion Proceedings, pp. 1-3(2020).

# Additional sources:

1. Ruhe G. Software engineering decision support–a new paradigm for learning software organizations International Workshop on Learning Software Organizations, Springer (2002), pp. 104-113.

2. Kochhar PS, Wijedasa D., Lo D. A large scale study of multiple programming languages and code quality 2016 IEEE 23rd International Conference on Software Analysis, Evolution, and Reengineering, Vol. 1, SANER, IEEE (2016), pp. 563-573.

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